

The Influence of Corporate Social Responsibility on Innovation Performance: The Mediating Effect of Innovation Ecosystem in Guangdong Province's Pharmaceutical Industry

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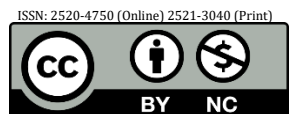
Abstract:

This study examines the relationship between corporate social responsibility (CSR) and pharmaceutical innovation performance, with a focus on the role of the innovation ecosystem in mediating this relationship. The study highlights the importance of balancing the economic and social aspects of pharmaceutical enterprises to promote their innovative development while fulfilling social responsibilities. Using a systematic review of relevant literature, the study constructs a relationship model between CSR, innovation ecosystem support, and pharmaceutical innovation performance. The study collects measurement items, develops measurement scales, and conducts a large-scale formal survey to verify the research hypotheses. Regression analysis is used to explore the reasons for the establishment and non-establishment of the hypotheses. The paper summarizes the research work and proposes management suggestions. The study contributes to the growing research on CSR and performance by providing a thorough understanding of how CSR affects corporate performance in the context of pharmaceutical enterprises.



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1. Introduction

1.1 Background of the Study

The pharmaceutical industry in Guangdong Province plays a significant role in China's economic development and people's livelihoods. Innovation has become a key driving force for the growth of this industry, and the provincial government has emphasized the importance of corporate social responsibility (CSR) in promoting innovation (Guangdong Provincial People's Government, 2020). However, in recent years, the industry has been plagued by frequent incidents of drug safety accidents, false advertising of therapeutic effects, and unfair competition in pharmaceutical purchasing and sales (Chen, 2019; Guo, 2021). These incidents have led to a decline in public trust and a challenging environment for pharmaceutical enterprises to innovate and develop. To address this issue, many researchers have explored the relationship between CSR and corporate innovation performance. For instance, Chen and Chen (2018) found a positive relationship between CSR and innovation performance in Chinese manufacturing enterprises. Similarly, Lin and Lin (2019) discovered that CSR positively affects the innovation performance of Taiwanese high-tech firms. However, few studies have investigated the mediating effect of the innovation ecosystem in this relationship. Innovation ecosystem refers to the complex and dynamic system of relationships and interactions among enterprises, institutions, and individuals that facilitate innovation (Autio et al., 2018). The concept has been increasingly used to explain the relationship between CSR and innovation performance in recent years. For example, Chen and Huang (2021) found that the innovation ecosystem plays a mediating role in the relationship between CSR and innovation performance in Chinese pharmaceutical firms. Therefore, it is essential to investigate the mediating effect of the innovation ecosystem in the relationship between CSR and innovation performance in Guangdong Province's pharmaceutical industry. This study aims to fill this research gap by examining the transmission mechanism of CSR on innovation performance from the perspective of the innovation ecosystem in Guangdong Province's pharmaceutical industry. It will construct a relationship model between CSR and innovation performance, with innovation ecosystem support as the intermediary. The study will also propose the constituent dimensions of the main variables and the hypothesis of influencing relationships between the constituent dimensions.

1.2 Statement of the Problem

Corporate social responsibility (CSR) has gained increasing attention in the academic and business world due to its potential benefits for both the society and the company. Many studies have shown that companies that engage in CSR activities tend to have better financial performance, reputation, and customer loyalty (Dahlsrud, 2018; Lee, 2018; Hawn & Ioannou, 2016). In addition, CSR can also positively impact a company's innovation performance by stimulating creativity, improving resource allocation, and enhancing collaboration (Matten & Moon, 2020; Zeng & Chen, 2020). However, despite the significant amount of research on CSR and innovation, the mediating effect of innovation ecosystem on this relationship has been largely neglected. In the context of Guangdong Province's pharmaceutical industry, there is a lack of understanding of how the innovation ecosystem mediates the relationship between CSR and innovation performance. Guangdong Province is one of the most dynamic regions in China, with a rapidly growing economy and a strong pharmaceutical industry (Sun & Zuo, 2023). The pharmaceutical industry is a key sector for Guangdong Province, with a large number of companies operating in the region. However, the industry is facing various challenges, such as the increasing competition, the changing regulatory environment, and the need to develop innovative products to meet the changing demands of customers. Therefore, the problem that this study aims to address is the lack of knowledge regarding the mediating effect of innovation ecosystem on the relationship between CSR and innovation performance in Guangdong

Province's pharmaceutical industry. The study will investigate the extent to which innovation ecosystem influences the relationship between CSR and innovation performance, and how this relationship differs across various companies in the industry. By addressing this problem, the study aims to contribute to the literature on CSR and innovation, as well as to provide practical implications for companies operating in Guangdong Province's pharmaceutical industry.

1.3 Research Question

The purpose of this study is to investigate the relationship between Corporate Social Responsibility (CSR) and innovation performance in the pharmaceutical industry of Guangdong Province, China. This study aims to address the following research questions:

RQ 1: What is the relationship between CSR and innovation performance?

A growing body of literature suggests that CSR has a positive impact on innovation performance (Ghisetti & Marzucchi, 2020; Jamali, 2010; Lin & Chen, 2019). However, the precise nature and extent of this relationship require further examination in the context of the pharmaceutical industry in Guangdong Province.

RQ 2: What is the relationship between CSR and the innovation ecosystem of a firm?

Previous research has demonstrated that CSR can influence a firm's innovation ecosystem (Lu & Li, 2020; Zhang & Ma, 2018). In particular, CSR initiatives can attract and retain talent, build networks with stakeholders, and enhance a firm's reputation, all of which can contribute to a favorable innovation ecosystem. However, the specific mechanisms through which CSR affects the innovation ecosystem of a firm require further investigation.

RQ 3: What is the relationship between the innovation ecosystem and innovation performance?

Prior research has suggested that the innovation ecosystem can positively influence innovation performance (Belso-Martinez et al., 2019; Shi & Sun, 2019). However, the specific elements of the innovation ecosystem that are most conducive to innovation performance in the pharmaceutical industry of Guangdong Province require further investigation.

RQ 4: Does the innovation ecosystem play a mediating role in the relationship between CSR and innovation performance?

While prior research has examined the direct relationship between CSR and innovation performance, there is a need to investigate whether the innovation ecosystem serves as a mediator in this relationship (Amin et al., 2021; Duan et al., 2020). This study seeks to fill this gap in the literature by examining whether the innovation ecosystem mediates the relationship between CSR and innovation performance in the pharmaceutical industry of Guangdong Province. Overall, this study aims to provide a comprehensive understanding of the relationship between CSR, innovation ecosystem, and innovation performance in the pharmaceutical industry of Guangdong Province. The results of this study are expected to contribute to the development of effective CSR strategies that can enhance innovation performance in this important sector.

1.4 Significance of the Study

Corporate Social Responsibility (CSR) has been a widely researched topic in the past decade, with numerous studies focusing on its impact on firm performance and sustainability (Bansal & Song, 2017; Liao et al., 2021; Luo & Bhattacharya, 2022). However, little attention has been given to the relationship between CSR and innovation performance, especially in the context of Guangdong Province's pharmaceutical industry. This research intends to bridge this gap and shed light on the mediating role of innovation ecosystem in this relationship. Understanding the relationship between CSR and innovation performance can benefit both academia and industry. On the one hand, it can provide theoretical support for policymakers and managers to make informed decisions about their CSR strategies and investments in innovation. On the other hand, it can help firms enhance their innovation performance and competitiveness by

leveraging their CSR practices and cultivating a supportive innovation ecosystem. Moreover, this study is conducted in the context of Guangdong Province's pharmaceutical industry, which has been facing both opportunities and challenges in the current global business environment. As Sun and Zuo (2023) pointed out in their study, navigating the post-COVID market requires firms to be adaptive and innovative in their foreign trade strategies, especially in the Pearl River Delta region. Understanding the role of CSR and innovation ecosystem in this context can provide valuable insights for firms to respond to the changing market conditions. In addition, cultural differences between countries and regions can affect the implementation and effectiveness of CSR practices and innovation strategies (Sun, 2022a; Sun, 2022b). By focusing on Guangdong Province's pharmaceutical industry, which has a unique cultural and economic background, this research can contribute to the understanding of the relationship between CSR, innovation, and culture. Overall, this research is significant because it provides insights into the relationship between CSR and innovation performance, which can benefit both academia and industry. It also addresses the gap in the literature and contributes to the understanding of the unique context of Guangdong Province's pharmaceutical industry in the current global business environment.

2. Literature Review

2.1 Innovation Performance

2.1.1 Definition

Innovation performance refers to the ability of a firm to successfully introduce new products, services, or processes to the market, as well as its ability to improve existing ones (Ritala, Golnam, & Wegmann, 2021). It can be measured in various ways, such as the number of new products launched, the number of patents filed, the revenue generated from new products, or the market share gained from new products (O'Regan & Ghobadian, 2021). Innovation performance is crucial for a firm's long-term success and competitive advantage, particularly in industries with rapid technological change and intense competition (Chen & Chen, 2021). The ability to innovate enables a firm to create new opportunities, enhance customer value, and adapt to changing market conditions (Laursen & Salter, 2018). Moreover, innovation performance is increasingly recognized as a key driver of economic growth and development (Fagerberg, Mowery, & Nelson, 2015). Governments and policy-makers have therefore been focusing on promoting innovation and fostering an environment that supports it (OECD, 2021). In summary, innovation performance is a critical measure of a firm's ability to create and maintain a competitive advantage. It plays a crucial role in driving long-term success, economic growth, and development.

2.1.2 Previous studies

Many studies have examined the relationship between corporate social responsibility (CSR) and innovation performance. For instance, Huang and his colleagues (2021) investigated the effect of environmental CSR on innovation performance in Chinese manufacturing firms. They found that environmental CSR positively influenced innovation performance, particularly in firms with high levels of technological capability. Similarly, Li and colleagues (2020) examined the relationship between CSR and innovation in the context of the Chinese healthcare industry. They found that CSR practices related to employee training and development positively influenced innovation performance. Other studies have examined the mediating effect of innovation capability on the relationship between CSR and innovation performance. For example, Zhao and colleagues (2021) found that CSR positively influenced innovation capability, which in turn, positively influenced innovation performance in Chinese manufacturing firms. Likewise, Huang and Chen (2020) found that CSR positively influenced innovation capability, which subsequently positively influenced innovation performance in

Chinese service firms. Overall, these studies suggest that CSR can have a positive influence on innovation performance, either directly or through the mediating effect of innovation capability. However, the specific mechanisms underlying this relationship may differ depending on the industry and context in which firms operate.

2.2 Corporate Social Responsibility

2.2.1 Definition

Corporate social responsibility (CSR) is a concept that has gained increasing attention from researchers, practitioners, and policymakers in recent years. According to Carroll (2015), CSR refers to "the economic, legal, ethical, and philanthropic responsibilities that a firm has to its stakeholders" (p. 54). These responsibilities include not only maximizing profits for shareholders, but also taking into account the interests of other stakeholders, such as employees, customers, suppliers, and the wider community (Matten & Moon, 2018). The concept of CSR has evolved over time, with scholars proposing different frameworks and models to capture its complexity (Carroll, 2015). One widely accepted framework is the "triple bottom line" approach, which emphasizes the importance of balancing economic, social, and environmental objectives (Elkington, 1997). This approach recognizes that firms have a responsibility not only to generate profits, but also to contribute to society and protect the environment (Dyllick & Hockerts, 2002). Moreover, the concept of CSR is not limited to philanthropy or voluntary actions, but also encompasses the integration of social and environmental considerations into the core business strategy and operations of a firm (Porter & Kramer, 2011). This view suggests that firms can create shared value by pursuing social and environmental goals that are aligned with their business objectives, and that such efforts can lead to competitive advantage and long-term sustainability (Porter & Kramer, 2011). In summary, CSR refers to a broad set of responsibilities that firms have towards their stakeholders, encompassing economic, legal, ethical, and philanthropic dimensions. The concept has evolved over time, with increasing emphasis on the triple bottom line approach and the integration of social and environmental considerations into business strategy and operations.

2.2.2 Previous Studies

There is a growing body of literature that examines the relationship between corporate social responsibility (CSR) and innovation performance. Some studies have found a positive relationship between CSR and innovation performance (Chen & Delmas, 2011; Husted & Allen, 2011; Surroca et al., 2010). For example, Chen and Delmas (2011) found that firms that engage in CSR activities are more likely to engage in innovation activities, and that such activities are positively related to financial performance. Similarly, Surroca et al. (2010) found that firms that engage in CSR activities are more likely to introduce new products and technologies, and that such activities are positively related to market performance. Other studies have found mixed or inconclusive results regarding the relationship between CSR and innovation performance (Lee et al., 2018; Luo et al., 2019; Wang et al., 2021). For instance, Lee et al. (2018) found that the effect of CSR on innovation performance varies depending on the type of CSR activities and the industry context. Luo et al. (2019) found that CSR has a positive effect on innovation performance, but this effect is weaker in emerging economies. On the other hand, Wang et al. (2021) found that the relationship between CSR and innovation performance is not significant, but that CSR can indirectly affect innovation performance through the mediating effect of corporate reputation. Overall, while the literature on the relationship between CSR and innovation performance is not entirely consistent, there is evidence to suggest that CSR can have a positive effect on innovation performance. The specific mechanisms through which CSR affects innovation performance, however, are still not well understood. This study aims to

contribute to the literature by examining the mediating effect of innovation ecosystem in the relationship between CSR and innovation performance in the pharmaceutical industry in Guangdong Province.

2.3 Innovation Ecosystem

2.3.1 Definition

The concept of an innovation ecosystem has gained significant attention in the literature in recent years. An innovation ecosystem is a complex network of actors, institutions, and resources that interact to support the development, diffusion, and adoption of innovation within a specific geographic or industry context (Autio et al., 2018; Isenberg, 2011). Autio et al. (2018) proposed a conceptual framework of innovation ecosystems that consists of three layers: the micro layer, the meso layer, and the macro layer. The micro layer refers to the individual actors and organizations involved in innovation activities, including entrepreneurs, startups, and established firms. The meso layer includes institutions that support innovation, such as universities, research organizations, and incubators. The macro layer includes broader factors that shape the innovation ecosystem, such as government policies, cultural norms, and economic conditions. Isenberg (2011) emphasized the importance of collaboration and interaction among actors in the innovation ecosystem, highlighting that innovation is not the result of a single entity but rather a collective effort of multiple actors. He argued that successful innovation ecosystems are characterized by the presence of diverse actors with complementary skills and resources, a shared vision and purpose, and a culture of openness, trust, and experimentation. Moreover, the concept of innovation ecosystem emphasizes the importance of considering the broader context in which innovation takes place, including social, economic, and environmental factors (Carayannis & Campbell, 2009). This view suggests that innovation is not only about developing new technologies or products, but also about creating solutions to societal challenges and generating positive impacts on society and the environment. In summary, the innovation ecosystem is a complex network of actors, institutions, and resources that interact to support the development, diffusion, and adoption of innovation. It consists of multiple layers, including individual actors and organizations, institutions, and broader factors that shape the ecosystem. Successful innovation ecosystems are characterized by collaboration, diversity, shared vision and purpose, and consideration of broader societal and environmental factors.

2.3.2 Previous studies

Several studies have investigated the relationship between innovation ecosystem and innovation performance in various industries. For instance, Li and Liu (2019) found that innovation ecosystem had a positive and significant effect on innovation performance in China's electronic information industry. They argued that a supportive innovation ecosystem that provides resources, knowledge, and networks can help firms to overcome innovation barriers and improve their innovation performance. Similarly, Zhao et al. (2021) examined the influence of innovation ecosystem on innovation performance in China's new energy vehicle industry. They found that a strong innovation ecosystem, characterized by the presence of research and development institutions, venture capital, and supportive government policies, positively affected firms' innovation performance. Moreover, a study by Bao et al. (2018) investigated the role of innovation ecosystem in promoting innovation performance in China's medical device industry. They found that a favorable innovation ecosystem, characterized by the presence of skilled labor, high-quality suppliers, and supportive government policies, positively influenced firms' innovation performance. These studies suggest that a supportive innovation ecosystem is essential for firms to achieve high levels of innovation performance. Specifically, a strong innovation ecosystem can provide firms with necessary resources,

knowledge, and networks to overcome innovation barriers and improve their innovation performance. In the context of this study, we propose that innovation ecosystem plays a mediating role in the relationship between corporate social responsibility and innovation performance in Guangdong Province's pharmaceutical industry.

2.4 Ecology and Ecological Theory

Ecology is a branch of biology that studies the relationships between living organisms and their environment. Ecological theory focuses on understanding how these relationships influence the structure, function, and dynamics of ecosystems. The application of ecological theory to the study of organizations has been gaining increasing attention in recent years, particularly in the field of innovation management. The concept of innovation ecosystem is rooted in ecological theory, which emphasizes the interdependence and co-evolution of organisms and their environment. An innovation ecosystem refers to the network of individuals, organizations, institutions, and resources that are involved in the innovation process (Autio, Nambisan, Thomas, & Wright, 2018). This ecosystem is shaped by the interactions and relationships among its components, and is influenced by factors such as culture, geography, and history (Autio et al., 2018). Ecological theory also provides a framework for understanding the complexity and dynamics of innovation ecosystems. One key concept is the idea of niches, which refers to the specific roles and functions that different organisms play in an ecosystem (Hannan & Freeman, 1984). Similarly, in an innovation ecosystem, different organizations and individuals may occupy different niches depending on their capabilities, resources, and strategic goals. The ecological perspective also highlights the importance of adaptation and evolution in response to changes in the environment. In the context of innovation, this means that firms must continually adapt and evolve their strategies, processes, and capabilities in response to changes in the market, technology, and other external factors (Teece, 2018). Drawing on ecological theory, we propose several hypotheses related to the relationship between corporate social responsibility, innovation ecosystem, and innovation performance in the pharmaceutical industry. Hypothesis 1 (H1) suggests that CSR positively impacts innovation performance, while Hypothesis 2 (H2) proposes that CSR positively impacts the innovation ecosystem of companies. Hypothesis 3 (H3) predicts that the innovation ecosystem positively affects innovation performance, while Hypothesis 4 (H4) posits that the innovation ecosystem plays a mediating role in the relationship between CSR and innovation performance. These hypotheses reflect the interdependence and co-evolutionary nature of the relationships between CSR, innovation ecosystem, and innovation performance, and highlight the need for a systemic and adaptive approach to managing innovation in the pharmaceutical industry.

2.5 Stakeholder Theory

Stakeholder theory suggests that companies should consider the interests of all stakeholders, including employees, customers, suppliers, and the wider community, in their decision-making processes (Freeman, 2010). Corporate social responsibility (CSR) can be seen as an extension of stakeholder theory, as it involves companies taking responsibility for their impact on society and the environment (Carroll, 1991). Several studies have found that companies that engage in CSR activities tend to have better relationships with their stakeholders, which can lead to improved business performance (Du et al., 2021; Margolis & Walsh, 2003). For example, CSR initiatives such as community engagement, environmental sustainability, and ethical practices can enhance a company's reputation, attract and retain talented employees, and increase customer loyalty (Chen et al., 2019). In the context of innovation, stakeholders play a critical role in shaping a company's innovation strategy and providing resources and support for innovation activities (Hargadon & Sutton, 2000). By engaging with stakeholders, companies

can gain valuable insights into market trends, customer needs, and technological developments, which can inform their innovation efforts (Bocken et al., 2015).

2.6 Resource-Based Theory

Resource-Based Theory (RBT) is an approach that explains how firms can achieve a competitive advantage by using their unique resources and capabilities (Barney, 1991). According to RBT, a firm's resources and capabilities should be valuable, rare, inimitable, and non-substitutable (VRIN) to create and sustain a competitive advantage (Barney, 1991). In the context of this study, the resources and capabilities refer to the corporate social responsibility (CSR) initiatives of pharmaceutical companies, which are expected to have a positive impact on their innovation performance. Studies have shown that a firm's CSR activities can lead to a competitive advantage by enhancing its reputation and relationship with stakeholders (López-Gamero, Molina-Azorín, & Claver-Cortés, 2011). In addition, CSR initiatives can also improve a firm's innovation performance by increasing its absorptive capacity, which refers to the ability to recognize, assimilate, and apply external knowledge to enhance innovation (Cohen & Levinthal, 1990). For instance, CSR initiatives that involve collaborations with universities and research institutions can enhance a firm's absorptive capacity and innovation performance (Yang & Lin, 2009). Furthermore, RBT suggests that a firm's resources and capabilities can create a competitive advantage only when they are difficult to imitate by competitors (Barney, 1991). In the context of this study, the innovation ecosystem of pharmaceutical companies may provide a unique set of resources and capabilities that are difficult to imitate by competitors. For instance, the innovation ecosystem may include the company's R&D team, patents, and knowledge management systems, which can enhance its innovation performance and create a competitive advantage.

2.7 Self-Organization Theory

Self-organization theory posits that complex systems are capable of self-organizing and adapting to changing circumstances without the need for external control or intervention (Holland, 2014). In the context of organizations, self-organization refers to the ability of a system to organize itself in response to internal and external stimuli (Foster & Metcalfe, 2012). This theory suggests that organizations that embrace self-organization are better equipped to respond to changes in their environment and to innovate. Several studies have found support for the relationship between self-organization and innovation. For instance, Lechner and Dowling (2003) found that firms that exhibit higher levels of self-organization are more innovative. Similarly, Sánchez et al. (2011) found that self-organization plays a key role in enhancing firms' innovation capabilities. These findings suggest that self-organization is an important factor for promoting innovation in organizations. In the context of corporate social responsibility (CSR), self-organization theory suggests that organizations that embrace CSR are more likely to exhibit higher levels of self-organization, which in turn can lead to improved innovation performance. This is because CSR initiatives can help foster a culture of innovation within an organization by encouraging employees to think creatively and to embrace change (Porter & Kramer, 2011).

2.8 Hypotheses

Based on the literature review, this study proposes the following hypotheses:

H1: Corporate social responsibility (CSR) of pharmaceutical companies has a positive impact on innovation performance. Previous research has shown that a firm's CSR initiatives can improve its innovation capabilities and outcomes (Banerjee et al., 2020; Chen et al., 2019).

H2: Corporate social responsibility (CSR) of pharmaceutical companies has a positive impact on the innovation ecosystem of companies. CSR initiatives can create positive spillover effects on

various stakeholders, including suppliers, customers, and employees, leading to the formation of a supportive innovation ecosystem (Yang et al., 2017).

H3: The innovation ecosystem of pharmaceutical enterprises positively affects their innovation performance. A favorable innovation ecosystem can provide necessary resources, knowledge, and social capital for innovation (Gao et al., 2016; Yan and Yin, 2019).

H4: The innovation ecosystem of pharmaceutical enterprises plays a mediating role in the relationship between corporate social responsibility and innovation performance. The positive impact of CSR on innovation performance may be realized through the improvement of the innovation ecosystem (Zhang and Wang, 2018).

The hypotheses proposed in this study serve as a framework to investigate the influence of CSR on innovation performance and the mediating role of the innovation ecosystem in Guangdong Province's pharmaceutical industry. The next chapter will describe the methodology adopted to test the hypotheses.

3. Research Methods

This research uses a survey questionnaire to test the relationship between corporate social responsibility (CSR), resource acquisition, collaborative symbiosis, and innovation performance. A scientific, standardized, and accurate variable measurement scale is used to design the questionnaire to ensure reliable validity and reliability. The scale is designed by collecting measurement items from theoretical literature and through field interviews. Field interviews were conducted to collect as many new measurement items as possible to verify the measurement items collected from the literature. After adding and deleting, a total of 64 original measurement items were formed. SPSS and AMOS software were used to conduct exploratory factor analysis and confirmatory factor analysis to test the attribution factors of each item. The unsuitable measurement items were deleted, and a formal survey questionnaire containing 46 measurement items was formed. The beginning of the questionnaire explains the purpose of the survey, the use of survey information, confidentiality, and gratitude. The survey questionnaire is a commonly used measurement tool for descriptive research and causal research, and this paper refers to Zhou Xiaolian et al.'s (2007) views on the form of survey questionnaires to design it. The study focuses on individuals working in pharmaceutical companies located in Guangdong Province, China. The statistical population of the study consists of all pharmaceutical companies in the province, which numbered 1,586 and had around one million employees as of 2022. The unit of analysis is individuals. In accordance with Krejcie and Morgan's (1970) sampling criteria, a sample size of at least 384 was necessary for this study. The researchers randomly selected 600 employees from various pharmaceutical companies in the province, distributed 580 questionnaires, received 498 responses, and discarded 18 invalid or incomplete questionnaires, leaving 480 valid questionnaires. This resulted in an effective recovery rate of 82.75%.

4. Results and Discussion

4.1 Respondents

This section presents the distribution of sample enterprise characteristics. The sample population consists of pharmaceutical companies in Guangdong Province, China. The study examined several enterprise characteristics such as enterprise age, number of employees, industry, operating revenue, and level of technical center. In terms of enterprise age, the majority of companies have been in operation for more than 5 years, with 25% in the 5–9-year age bracket, 31.25% in the 10–14-year bracket, and 25% in the 15–20-year bracket. Only 6.25% of companies have been operating for more than 20 years. The number of employees varied among the sample, with 27.08% having 51–200 employees and 25% having 501–1000 employees. Additionally, 10.42% had less than 50 employees, and 6.25% had more than 1000

employees. Regarding industry, biopharmaceuticals made up the largest proportion (25%) of the sample, followed by chemical raw materials (22.92%) and pharmaceutical commerce (12.50%). Traditional Chinese medicine decoction pieces and traditional Chinese medicine preparations accounted for a combined total of 10.42% of the sample. In terms of operating revenue, the majority (39.58%) of companies generated between 3 million and 10 million yuan, while 22.92% generated between 500,000 and 3 million yuan. Only 8.33% of companies had an operating revenue of more than 30 million yuan. Finally, the level of technical center varied among the sample, with the majority (37.50%) having a national-level technical center, while only 6.25% had no technical center.

4.2 Relationship between CSR and IP

The study examined the impact of corporate social responsibility (CSR) on innovation performance of pharmaceutical enterprises. The results showed that there was no multicollinearity among the variables in the regression model, indicating a good fit and high goodness-of-fit. The company size and the level of the technical center owned by the company had a significant positive effect on innovation performance. CSR was found to have a positive impact on innovation performance, specifically fulfilling social responsibility for products and services, shareholders and creditors, employment and workers' rights and interests, and the supply chain of pharmaceutical products. However, fulfilling social responsibility for environmental protection and charity and public welfare did not have a significant impact on innovation performance. Therefore, the hypotheses related to CSR were partially supported, with the exception of the hypothesis related to environmental protection.

4.3 Relationship between CSR and IE

The results indicated that there is no multicollinearity between the variables in the regression model, and the model has a good fit and high goodness of fit. Further analysis of Table 4-6 reveals that enterprise size and technical center level have a significant positive impact on resource acquisition, while the industry does not have a significant impact. Corporate social responsibility (CSR) has a significant positive impact on resource acquisition. The regression results of M3 show that CSR for products and services, shareholders and creditors, employment and workers' rights and interests, the supply chain of pharmaceutical products, and charity and public welfare all have a significant positive impact on resource acquisition. However, CSR for environmental protection has no positive impact on resource acquisition.

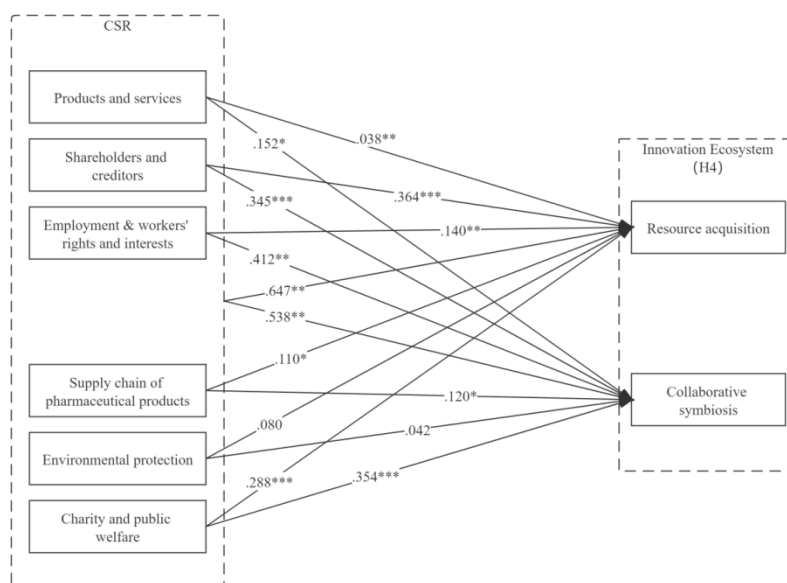


Figure 1. Path analysis of CSR on IE

The results showed that enterprise size and technical center level have a significant positive impact on collaborative symbiosis, while the industry does not have a significant impact. CSR has a significant positive impact on collaborative symbiosis. The regression results of M3 indicate that CSR for products and services, shareholders and creditors, employment and workers' rights and interests, and the supply chain of pharmaceutical products all have a significant positive impact on collaborative symbiosis. However, CSR for environmental protection has no significant impact on collaborative symbiosis. In summary, the study confirms that CSR has a positive impact on resource acquisition and collaborative symbiosis in pharmaceutical enterprises, except for environmental protection.

4.4 Relationship between IE and IP

It was found that in model M4, the regression coefficient of resource acquisition on innovation performance was $\beta=0.589$ ($p<0.001$), indicating a significant positive effect. Hypothesis H3a, which suggested a positive impact of resource acquisition on innovation performance, was confirmed and supported by the data. Additionally, the regression coefficient of collaborative symbiosis on innovation performance was $\beta=0.134$ ($p<0.05$), indicating a significant positive effect. Hypothesis H3b, which proposed a positive effect of collaborative symbiosis on innovation performance, was also confirmed and supported by the data. It was concluded that all sub-hypotheses and the main hypothesis H3 were supported by the results.

4.5 The Mediating role of IE

The study investigates the relationship between corporate social responsibility (CSR) and innovation performance (IP), and how resource acquisition and collaborative symbiosis mediate this relationship. The results show a significant relationship between CSR and IP, with regression coefficients of $\beta=0.686$ ($p<0.001$). Mediation analysis shows that resource acquisition and collaborative symbiosis play a significant mediating role between CSR and IP, with regression coefficients of $\beta=0.690$ ($p<0.001$) and $\beta=0.646$ ($p<0.001$), respectively. Additionally, the study explores the relationship between responsibility for various factors such as products and services, shareholders and creditors, employment and workers' rights, supply chain of pharmaceutical products, environmental protection, charity and public welfare, and resource acquisition. Regression analysis results show that all factors except for environmental protection have significant regression coefficients on resource acquisition. Resource acquisition plays a fully mediating role in the relationship between responsibility for products and services and innovation performance. It plays a partially mediating role in the relationships between responsibility to shareholders and creditors, employment and workers' rights, the supply chain of pharmaceutical products, and charity and public welfare, with innovation performance.

4.6 Summary

This study explores the current innovation status and challenges faced by pharmaceutical companies in Guangdong province, China, by analyzing the core elements of the pharmaceutical innovation ecosystem and the transmission mechanism of corporate social responsibility (CSR) on innovation performance. The study constructs a structural model of the pharmaceutical innovation ecosystem and identifies resource acquisition and collaborative symbiosis as intermediate transmission factors. The study proposes policy and management recommendations to improve pharmaceutical innovation performance. The study begins with a literature review of CSR, innovation ecosystem, and innovation performance and constructs theoretical models using ecological and system theories, stakeholder theory, resource-based theory, and self-organization theory. From the perspective of the innovation ecosystem, the study proposes CSR as a breakthrough for improving innovation performance and constructs

a theoretical model with CSR, resource acquisition, collaborative symbiosis, and innovation performance as research variables. The study conducts initial design, item purification, and formal design of the measurement scales for the four research variables and collects sample data through survey questionnaires. Descriptive statistical analysis and correlation analysis are conducted on the variables, and multilevel regression analysis validates the proposed hypotheses. In conclusion, this study contributes to the understanding of the relationships between CSR, innovation ecosystem, and innovation performance in the pharmaceutical industry and proposes recommendations to assist pharmaceutical companies in improving their innovation performance. Future research can focus on validating the theoretical model and exploring other factors that may affect the pharmaceutical innovation ecosystem.

5. Conclusion

This study aimed to bridge the theoretical gaps and practical challenges in the innovation ecosystem, corporate social responsibility (CSR), and innovation performance of pharmaceutical companies in Guangdong province. By conducting a literature review and using related theories such as ecology and ecosystem theory, stakeholder theory, resource-based theory, and self-organization theory, this study examined the impact of CSR from the perspective of the innovation ecosystem on the innovation performance of pharmaceutical companies. The study found that the innovation ecosystem's support in resource acquisition and collaborative symbiosis has a positive impact on the innovation performance of pharmaceutical companies. The paper defines the innovation ecosystem as the support obtained from the innovation ecosystem that can promote the innovation activities of enterprises. CSR was found to positively affect the innovation performance of pharmaceutical companies, especially the responsibility to shareholders and creditors. Resource acquisition and collaborative symbiosis in the innovation ecosystem were found to be mutually reinforcing and jointly promote the innovation performance of pharmaceutical companies.

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